

Attorney Docket No.: 9151.26

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Hamilton et al. Confirmation No.: 6693
Application Serial No.: 10/629,259 Group No.: 3737
Filed: July 29, 2003 Examiner: Amanda L. Lauritzen
For: CARDIAC DIAGNOSTICS USING TIME COMPENSATED STRESS TEST
CARDIAC MRI IMAGING AND SYSTEMS FOR CARDIAC DIAGNOSTICS

Date: August 18, 2008

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANTS' BRIEF ON APPEAL UNDER 37 C.F.R. § 41.37

Sir:

This Appeal Brief is filed pursuant to the "Notice of Appeal to the Board of Patent Appeals and Interferences" filed on March 10, 2008 and the Notice of Panel Decision dated July 17, 2008.

REAL PARTY IN INTEREST

The real party in interest is **Wake Forest University Health Sciences, Winston-Salem, North Carolina**, the assignee of this application by virtue of an assignment recorded at real number 014362 and frame number 0440.

RELATED APPEALS AND INTERFERENCES

Appellants are aware of no appeals or interferences that would be affected by the present appeal.

STATUS OF CLAIMS

Claims 1-34 are pending in the present application as of the filing date of this Brief. As of the filing date of this Brief, Claims 1-34 remain rejected in the Final Office Action dated January 10, 2008 (the "Action"). Appellants appeal the final rejection of Claims 1-34.

STATUS OF AMENDMENTS

The Appendix of Claims submitted herewith reflects the state of the claims of record.

SUMMARY OF THE CLAIMED SUBJECT MATTER

Claim 1 relates to methods of cardiac diagnostics of a patient. A stress test is administered to the patient. *See* Figure 4, Block 400; page 10, lines 28-31. A plurality of different views of MRI cine-loops of the heart of the patient are acquired at a plurality of heart rates, the different views comprising some views associated with a first anatomical view at different heart rates induced by different doses of a stress-inducing substance and some views associated with different anatomical views at a substantially constant heart rate. *See* Figure 4, Blocks 402 and 404; page 10, line 31 – page 11, line 11. The MRI cine-loops are generated using multiple MRI images that form the frames of the cine loops. *See* Figure 4, Blocks 402 and 404; page 10, line 31 – page 11, line 11. The plurality of MRI cine loops are temporally synchronized. *See* Figure 4, Block 404 and 406; page 11, lines 3-9. The plurality of temporally synchronized MRI cine loops are adjusted based on a heart rate associated with respective ones of the MRI cines so as to compensate for differences in heart rate so that each MRI cine loop has substantially the same duration. *See* page 11, lines 10-11. A plurality of the adjusted MRI cine loops are displayed at a clinician workstation in substantially real-time while the patient is in an MRI scanner used for the acquiring step. *See* page 13, lines 19-24. A clinician is allowed to electronically select at least one of the following: (a) at least one dose amount; (b) at least one view; or (c) at least one dose amount and at least one view to define the MRI cine loops for the displaying step. *See* page 11, lines 11-20. The compensated MRI cine loops are evaluated so as to assess a state of coronary physiology of the patient. *See* page 11, lines 11-20. The cine loops are displayed during the stress test to allow a physician to assess cardiac physiology of a patient so as to adjust parameters of the test and/or avoid injury to the patient thereby providing safer cardiac stress testing. *See* page 11, line 27 – page 12, line 14.

Claim 21 relates to methods of displaying MRI cine loops. *See* page 14, lines 7-18. A characteristic of one frame of a plurality of frames of an MRI cine loop is adjusted. *See*

Figure 6, Block 600; page 14, lines 8-10. The MRI cine-loops are generated using multiple MRI images that form the frames of the cine loops. *See* Figure 6, Block 602; page 14, lines 10-18. The characteristic is at least one of contrast, brightness, and gamma. *See* Figure 6, Block 600; page 14, lines 8-10. The adjustment of the one frame is propagated to other frames of the MRI cine loop. *See* Figure 6, Block 602; page 14, lines 10-18.

Claim 24 depends from Claim 21 and further recites that adjusting a characteristic comprises adjusting a contrast or brightness of a display level of the frame. *See* Figure 6, Block 600; page 14, lines 8-10.

Claim 25 depends from Claim 1 and further recites obtaining MRI images for the MRI cine loops using a fast gradient echo segmented k-space sequence having sufficient temporal resolution for identification of end of systole. *See* page 7, line 32 – page 8, line 5. The temporal resolution is between about 13-65 ms, with lower times corresponding to faster heart beats and higher times corresponding to slower heartbeats. *See* page 7, line 32 – page 8, line 5. The MRI cine loops are obtained using breathhold durations between about 10-23 seconds, and the longer breathhold durations are associated with faster heart beat rates. *See* page 7, line 32 – page 8, line 7.

Claim 28 depends from Claim 1 and further recites electronically automatically comparing a baseline MRI cine loop of the patient to MRI cine loops at different heart rates. *See* page 8, lines 14-16. Claim 29 depends from Claim 28 and further recites electronically registering the differing MRI cine loops to the baseline loops such that corresponding pixels of the cine loops or portions of the cine loops are each associated with approximately a same physical location within the patient. *See* page 12, line 30-33.

Claim 30 depends from Claim 1 and recites that the allowing a clinician to electronically select step comprises providing electronic user inputs displayed apart from the display images of the MRI cine loops that are associated with selectable views and doses of the MRI cine loops that allow a user to select both at least one view and at least one dose amount for the MRI cine loops for the displaying step. *See* page 8, line 7 – page 10, line 27; page 14, lines 2-6.

Claim 33 depends from Claim 1 and recites that the step of allowing the clinician to

electronically select at least one of the following: (a) at least one dose amount; (b) at least one view; or (c) at least one dose amount and at least one view to define the MRI cine loops for the displaying step allows the clinician to select each of (a), (b) and (c). The step of allowing the clinician to select is carried out to allow the clinician to rapidly switch between various display mechanisms. *See* page 14, lines 2-6. Claim 34 depends from Claim 33 and recites that the display is configured to accept user input to electronically select a plurality of dose amounts and a plurality of side-by-side anatomical views in response to clinician input whereby selected MRI cine loops are displayed responsive thereto. *See* page 14, lines 2-6. The display is configured to rapidly switch between various display mechanisms for evaluating the MRI cine loops of different doses of the stress-inducing substance at a same location of the heart and different locations of the same dose of the stress inducing substance. *See* page 14, lines 2-6.

GROUND OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether Claims 1-20, 24, 25, 29, 30 and 32 are properly rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement.
2. Whether Claims 1-10, 12-19, 25-27, 28-29 and 31-34 are properly rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,619,995 to Lobodzinski ("Lobodzinski") in view of U.S. Patent No. 5,997,883 to Epstein ("Epstein").
3. Whether Claim 11 is properly rejected under 35 U.S.C. 103(a) as being unpatentable over Lobodzinski in view of Epstein and in further view of U.S. Publication No. 2003/0206646 to Brackett ("Brackett").
4. Whether Claim 20 is properly rejected under 35 U.S.C. 103(a) as being unpatentable over Lobodzinski in view of Epstein and in further view of U.S. Patent No. 6,500,123 to Holloway ("Holloway").
5. Whether Claims 21-24 and 30 are properly rejected under 35 U.S.C. 103(a) as being unpatentable over Lobodzinski in view of U.S. Publication No. 2004/0015079 to Berger ("Berger") in view of U.S. Patent No. 5,680,862 to Song ("Song").

ARGUMENT

I. The Section 112 Rejections

A. Introduction

Under MPEP § 2163, the standard for evaluating compliance with § 112, first paragraph, is whether Appellants' disclosure, as of its filing, conveys with reasonable clarity that which is claimed. Moreover, the MPEP specifically points out that the subject matter of the claim need not be described literally in the specification. MPEP § 2163.02.

Furthermore, under MPEP § 2163.04, the Examiner has the initial burden of presenting "evidence or reasons" why persons skilled in the art would not recognize a description of the invention as claimed in Appellants' disclosure. Although, the MPEP does state that it may be sufficient for the Examiner to provide a "simple statement that there does not appear to be a written description of the claim limitation " _____ " in the application as filed," however, the sufficiency of such simple statements appears to be limited to cases where the support is not apparent and the applicant has not pointed out where the limitation is supported. MPEP § 2163.04 I.

Appellants submit that the Final Action has not met the burden of presenting "evidence or reasons" why persons skilled in the art would not recognize a description of the invention as claimed in Appellants' disclosure, and that Claims 1-20, 24-25, 29, 30 and 32 are fully supported by the application as originally filed for at least the following reasons.

B. Claims 1-20, 24-25, 29, 30 and 32 Satisfy the Requirements of Section 112

The Final Action rejects Claims 1-20, 24, 25, 29, 30 and 32 for failing to comply with the written description requirement. The specific recitations identified in the Final Action as allegedly failing to comply with the written description requirement will now be discussed.

i. Claim 1

The Final Action alleges that the recitation in Claim 1 of "displaying a plurality of the adjusted MRI cine loops at a clinician workstation in substantially real-time *while the patient*

is in an MRI scanner used for the acquiring step" is not clearly pointed out in the specification.

Appellants submit that the application does provide sufficient support that reasonably conveys to one of skill in the art that the inventors had possession of the claimed invention. Specifically, the specification recites at p. 13:

In particular embodiments of the present invention, the display of cine loops is provided in real time. In other embodiments, the display of cine loops is provided in near real time. Such real time or near real time display of cine loops of a patient undergoing stress testing may be utilized to provide safe stress testing by allowing for rapid analysis and monitoring of the stress test such that patient injury may be avoided.

The specification also states at page 12, lines 7-11, that the evaluation process can be performed in a sufficiently real-time manner so as to allow a physician to utilize the MRI cine loops to monitor a stress test while the stress test is being performed. Such monitoring can provide early evidence of inducible ischemia to allow a physician to assess cardiac physiology of a patient so as to adjust parameters of the test and/or avoid injury to the patient, thereby providing safe stress testing as described for example, at pp.12 and 13.

Appellants respectfully submit that at least the above text clearly conveys that the patient is in the scanner during the clinician evaluation. Indeed, one of skill in the art would readily acknowledge and understand that both the described rapid analysis and monitoring in real or near real time as well as the ability to adjust test parameters to avoid injury are done while the patient is in the scanner. Set-up of a patient within the high-field magnet of MRI scanners is not instantaneous. Appellants submit that one of skill in the art would fully understand that to provide substantially real-time display during a stress test, the patient must remain inside the scanner/magnet bore.

Accordingly, the above recitations of Claim 1 are fully supported by the application as originally filed.

ii. Claims 1 and 32

The Action also states the recitations in Claim 1 and 32 specifying display "during the stress test" to "adjust parameters...to avoid injury" are also "not wholly supported" and

that there is no "reasonable expectation" for such details to be inferred. Again, Appellants strongly disagree and directs the reviewer's attention to at least the passages noted above. Particularly, the description at pp. 13, lines 19-24 states:

In particular embodiments of the present invention, the display of cine loops is provided in real time. In other embodiments, the display of cine loops is provided in near real time. Such real time or near real time display of cine loops of a patient undergoing stress testing may be utilized to provide safe stress testing by allowing for rapid analysis and monitoring of the stress test such that patient injury may be avoided.

(emphasis added). Page 12, lines 4-14 also states:

As discussed above, it has been found that the temporal synchronization process described herein allows for such a display without introducing inaccuracies, artifacts or other such distortions that would hinder the evaluation process. Furthermore, the evaluation process may be performed in a sufficiently real-time manner so as to allow a physician to utilize the MRI cine loops to monitor a stress test while the stress test is being performed. Such monitoring may be useful both in administering the stress test and in evaluation of a patient's condition based on the results of the stress test. By providing the cine loop information in a form that allows for simultaneous direct comparison of data for differing heart rates a physician may rapidly assess the cardiac physiology of a patient so as to adjust parameters of the test and/or avoid injury to the patient.

(emphasis added). Clearly, these claimed features of Claims 1 and 32 are sufficiently supported by the specification.

iii. Claim 29

With regard to Claim 29, the Action states that the application does not describe "registration of loops in relation to common physical locations of the heart, nor is it specified to take place prior to comparison." However, at page 12 (lines 30-33), the application states:

Such a registration may be provided utilizing conventional pattern recognition and/or alignment techniques such that

corresponding pixels of the cine loops or portions of the cine loops are each associated with approximately the same physical location within the patient.

Appellants reiterate the fact that Claim 29 as presented in Appellants' paper submitted September 11, 2007 recites this language from the specification nearly verbatim. Accordingly, Appellants respectfully submit that one skilled in the art would read the present application and conclude that the inventors were in possession of a method wherein the patient is in the scanner during the clinician evaluation as recited by Claim 1 and wherein the registration of the baseline loops to cine loops can be provided such that corresponding pixels are associated with the same physical location as recited by Claim 29.

Therefore, these recitations of Claim 29 are fully supported by the specification.

iv. Claims 24, 25 and 30

Claims 24, 25 and 30 also stand rejected for lack of support in the written description. However, the Action fails to indicate the reasoning for this since these claims as presented in Appellants' paper submitted September 11, 2007 no longer recite the language that was specifically objected to. No further reasoning was provided in the subsequent Office Action dated January 10, 2008, for maintaining this rejection with regard to these particular claims. Appellants submit that the recitations of Claims 24, 25 and 30 are fully supported by the specification.

C. Conclusion

Thus, for at least the foregoing reasons, Appellants respectfully request that the present application be reviewed and that the written description rejections of Claims 1-20, 24, 25, 29 and 30 be reversed.

II. The Section 103 Rejections

A. Introduction

As stated in the Examination Guidelines for Determining Obviousness Under 35

U.S.C. §103 in view of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc.* (M.P.E.P. §2141), a question regarding whether a claimed invention is obvious under 35 U.S.C. § 103 must include an analysis of the factors set forth in *Graham v. John Deere Co.* (383 U.S. 1, 148 USPQ 459 (1966)), which are described by the Supreme Court in the *KSR* decision to be 1) determining the scope and content of the prior art; 2) ascertaining the differences between the claimed invention and the prior art; and 3) resolving the level of ordinary skill in the pertinent art (hereinafter, the "*John Deere* factors"). The key to supporting any rejection under 35 U.S.C. 103 is the clear articulation of the reason(s) why the claimed invention would have been obvious. M.P.E.P. § 2143. A patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. *KSR Int'l Co. v. Teleflex Inc.*, 550 U. S. 1, 15 (2007). A Court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions. *Id.* at 13. When it is necessary for a Court to look at interrelated teachings of multiple patents, the Court must determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. *Id.* at 14.

As stated in the M.P.E.P. § 2143.02:

Reasonable Expectation of Success Is Required

A rational to support a conclusion that a claim would have been obvious is that all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded nothing more than predictable results to one of ordinary skill in the art. (emphasis added)(citing *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___, ___, 82 USPQ2d 1385, 1395 (2007); *Sakraida v. AG Pro, Inc.*, 425 U.S. 273, 282, 189 USPQ 449, 453 (1976); *Anderson's-Black Rock, Inc. v. Pavement Salvage Co.*, 396 U.S. 57, 62-63, 163 USPQ 673, 675 (1969); *Great Atlantic & P. Tea Co. v. Supermarket Equipment Corp.*, 340 U.S. 147, 152, 87 USPQ 303, 306 (1950))

Appellants submit that the present rejections should be reversed because the cited art does not disclose all of the elements recited in the claims, and there are no apparent reasons or reasonable expectation of success to modify or combine the references as proposed by the

Examiner. Moreover, the cited references teach away from Appellants' claimed invention.

B. Claims 1-10, 12-19, 25-27, 28-29 and 31-34 are Patentable

ii. Independent Claim 1

Claim 1 as presented herein recites a method of cardiac diagnostics of a patient, wherein a plurality of different views of MRI cine-loops of the heart of the patient at a plurality of heart rates is acquired and further wherein each MRI cine loop has substantially the same duration; displaying a plurality of the adjusted MRI cine loops at a clinician workstation in substantially real-time while the patient is in an MRI scanner used for the acquiring step; allowing a clinician to electronically select at least one of the following: (a) at least one dose amount; (b) at least one view; or (c) at least one dose amount and at least one view to define the MRI cine loops for the displaying step; and evaluating the compensated MRI cine loops so as to assess a state of coronary physiology of the patient.

Lobodzinski is directed to "video" signals, **not** MRI cine loops as claimed in the present invention. Lobodzinski states that "[t]he system of the present invention utilizes real-time image compression to store digitized video to a disc media in a continuous real-time fashion, thus making it possible to store the entire study with no possibility of losing data." (col. 5, lines 19-25). Lobodzinski states that "DIS generates a video signal 14 Other DIS may be ... a cardiac MRI apparatus.... The video signal can be generated in either analog or digital form. A Video Processor (VP) is in communication with the DIS for receiving the video signal." (col 8, lines 6-15).

Lobodzinski discusses various prior art methods such as X-ray angiography (col. 2, lines 37) and characterizes them as being different, because they use only selected still images (col. 2, lines 40-45) and do not utilize real-time video compression. Lobodzinski also states that its proposed methods are distinctively different from the described methods of stress echocardiography (col. 5, lines 15-18). Thus, Lobodzinski stresses the technical differences of video versus still images used for cine, such as those used with MRI cine loops (col. 2, lines 34-45, and col. 5, lines 10-25).

The instant invention does not employ a video signal coming from the MR scanner,

but rather employs separate digital snapshots of the heart taken at various times. As Lobodzinski states with respect to technologies that use still images, Appellants submit that the reverse is also true: the instant invention is "distinctively different" from the real-time video compression system proposed by Lobodzinski. MRI builds up a collection of snapshots of the heart at various points in the cardiac cycle, but these snapshots require many heartbeats to acquire, and, hence, are simply representative of typical images of the heart averaged over those many heartbeats. Further, there is only one set of frames spanning the one 'representative' heart cycle. In a video stream, there is a real-time stream of many heartbeats.

With respect to the fact that Lobodzinski states that MRI may be used (col. 8, line10), Appellants respectfully submit that, in the past, the MRI cine loops for cardiac stress analysis were asynchronous; that is, the MRI data for the cine loops was collected, then manipulated at a later time. In contrast, the present invention discloses synchronized, adjusted MRI cine loops that are displayed in substantially real-time. Further, with regard to cine loops, Lobodzinski states nothing more than "most diagnostic imaging systems provide some sort of cine loop review." (col. 2, lines 3-6) Notably, Lobodzinski goes on to also state that, "they typically do not provide digital motion video recording, serial comparison, and display functions." (*Id.*, emphasis added). Appellants submit that Lobodzinski's repeated discussions about the differences between the continuous real time video image compression technology as claimed therein from other motion video or the use still or selected images to form cine loops (col. 2, lines 33-45, col. 5, lines 10-25), in fact, teach away from the claimed subject matter.

Furthermore, Claim 1 also recites that the cine loops are displayed during the stress test to allow a physician to assess cardiac physiology of a patient so as to adjust parameters of the test and/or avoid injury to the patient thereby providing safer cardiac stress testing. Lobodzinski fails to teach or suggest providing synchronized, adjusted MRI cine loops that are displayed in substantially real-time, much less while a patient is in an MRI scanner as taught by the present invention. Such monitoring as taught by the present invention can provide early evidence of inducible ischemia to allow a physician to assess cardiac physiology of a patient so as to adjust parameters of the test and/or avoid injury to the patient, thereby

providing safe stress testing as described for example, at pp.12 and 13 of the specification. Embodiments of the present invention now generate the cine loops using multiple MRI images during a cardiac cycle that form the frames of a cine loop (this is **not** a real-time video stream as taught by Lobodzinski), during a stress test in a manner that allows for safe and more accurate cardiac stress tests. The generation of substantially real-time MRI cine loops to allow for improved safety during cardiac stress testing is novel and non-obvious over the cited prior art.

Accordingly, Appellants respectfully submit that Lobodzinski fails to teach or suggest the recitations of Claim 1 and, in fact, Lobodzinski teaches away from the present invention. The deficiencies of Lobodzinski are not cured by Estein.

For at least these reasons, Appellants respectfully request that rejection of Claim 1 be reversed based on the failure of the Examiner to establish a *prima facie* case of obviousness.

ii. Dependent Claims 2-10, 12-19, 25-27, 28-29 and 31-34

Dependent Claims 2-10, 12-19, 25-27, 28-29 and 31-34 are patentable at least by virtue of their depending from an allowable claim (Claim 1). Accordingly, Appellants respectfully request that the rejection of Claims 2-10, 12-19, 25-27, 28-29 and 31-34 also be reversed based on the failure of the Examiner to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 for at least the foregoing reasons.

C. Dependent Claim 11 is Patentable

Dependent Claim 11 is patentable at least by virtue of its depending from an allowable claim (Claim 1). The deficiencies of the prior art noted above are not cured by Brackett. Accordingly Appellants respectfully request that the rejection of Claim 11 also be reversed based on the failure of the Examiner to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 for at least the foregoing reasons.

D. Dependent Claim 20 is Patentable

Dependent Claim 20 is patentable at least by virtue of its depending from an allowable

claim (Claim 1). The deficiencies of the prior art noted above are not cured by Holloway. Accordingly Appellants respectfully request that the rejection of Claim 20 also be reversed based on the failure of the Examiner to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 for at least the foregoing reasons.

E. Claims 21-24 and 30 are Patentable

i. Independent Claim 21

Claim 21 recites that a characteristic of one frame of a plurality of frames of an MRI cine loop is adjusted. Claim 21 further recites that the MRI cine-loops are generated using multiple MRI images that form the frames of the cine loops, and the characteristic is at least one of contrast, brightness, and gamma. The adjustment of the one frame is propagated to other frames of the MRI cine loop.

As noted above with respect to independent Claim 1, Lobodzinski is directed to "video" signals and **not** to MRI cine loops as claimed in Claim 21. Lobodzinski discusses various prior art methods such as X-ray angiography (col. 2, lines 37) and characterizes them as being different, because they use only selected still images (col. 2, lines 40-45) and do not utilize real-time video compression. Lobodzinski also states that its proposed methods are distinctively different from the described methods of stress echocardiography (col. 5, lines 15-18). Thus, Lobodzinski stresses the technical differences of video versus still images used for cine, such as those used with MRI cine loops (col. 2, lines 34-45, and col. 5, lines 10-25).

Accordingly, Appellants submit that Lobodzinski does not disclose or render obvious the recitations of Claim 21, and the deficiencies of Lobodzinski are not remedied by Berger or Song, which are cited as allegedly disclosing cropping functions and user-adjusted brightness and contrast parameters.

ii. Dependent Claims 22-24 are Patentable

Dependent Claims 22-24 are patentable at least by virtue of its depending from an allowable claim (Claim 21). Accordingly Appellants respectfully request that the rejection of Claims 22-24 also be reversed based on the failure of the Examiner to establish a *prima facie*

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case of obviousness under 35 U.S.C. § 103 for at least the foregoing reasons.


iii. **Dependent Claim 30 is Patentable**

Dependent Claim 30 is patentable at least by virtue of its depending from an allowable claim (Claim 1). Accordingly Appellants respectfully request that the rejection of Claim 20 also be reversed based on the failure of the Examiner to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 for at least the foregoing reasons.

CONCLUSION

In view of the above discussion, Appellants submit that the rejection of Claims 1-34 should be reversed and the present application passed to issue.

Respectfully requested,

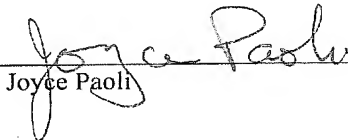

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Joyce Paoli

CLAIMS APPENDIX

Listing of Claims:

1. (Previously Presented) A method of cardiac diagnostics of a patient, comprising:
 - administering a stress test to the patient;
 - acquiring a plurality of different views of MRI cine-loops of the heart of the patient at a plurality of heart rates the different views comprising some views associated with a first anatomical view at different heart rates induced by different doses of a stress-inducing substance and some views associated with different anatomical views at a substantially constant heart rate, wherein the MRI cine-loops are generated using multiple MRI images that form the frames of the cine loops;
 - temporally synchronizing the plurality of MRI cine loops;
 - adjusting the plurality of temporally synchronized MRI cine loops based on a heart rate associated with respective ones of the MRI cines so as to compensate for differences in heart rate so that each MRI cine loop has substantially the same duration;
 - displaying a plurality of the adjusted MRI cine loops at a clinician workstation in substantially real-time while the patient is in an MRI scanner used for the acquiring step;
 - allowing a clinician to electronically select at least one of the following: (a) at least one dose amount; (b) at least one view; or (c) at least one dose amount and at least one view to define the MRI cine loops for the displaying step; and
 - evaluating the compensated MRI cine loops so as to assess a state of coronary physiology of the patient, wherein the cine loops are displayed during the stress test to allow a physician to assess cardiac physiology of a patient so as to adjust parameters of the test and/or avoid injury to the patient thereby providing safer cardiac stress testing.
2. (Original) The method of Claim 1, further comprising adjusting the administration of the stress test based on the evaluated compensated MRI cine loops.

3. (Original) The method of Claim 1, wherein the evaluation of the compensated MRI cine loops comprises determining a presence or absence of coronary artery disease based on the compensated MRI cine loops.

4. (Original) The method of Claim 1, further comprising simultaneously displaying a plurality of the compensated MRI cine loops.

5. (Original) The method of Claim 4, wherein at least one of the plurality of compensated MRI cine loops comprises a resting heart rate cine loop.

6. (Original) The method of Claim 4, wherein evaluation of the compensated MRI cine loops comprises determining a presence or absence of coronary artery disease based on the simultaneously displayed plurality of compensated MRI cine loops

7. (Original) The method of Claim 4, wherein simultaneously displaying a plurality of the compensated MRI cine loops comprises simultaneously displaying a plurality of cine loops for differing locations associated with the heart of the patient for a single dosage of a stress inducing agent.

8. (Original) The method of Claim 4, wherein simultaneously displaying a plurality of the compensated MRI cine loops comprises simultaneously displaying a plurality of cine loops for a single location associated with the heart of the patient for levels of stress of the patient.

9. (Previously Presented) The method of Claim 1, wherein adjusting the plurality of MRI cine loops comprises adding frames to at least one of the plurality of MRI cine loops.

10. (Previously Presented) The method of Claim 1, wherein the adjusting comprises adding and/or removing frames from respective ones of the MRI cine loops such that all of

the MRI cine loops have a same number of frames.

11. (Previously Presented) The method of Claim 10, wherein the adding and/or removing frames comprises adding frames by repeating frames of an MRI cine loop.

12. (Previously Presented) The method of Claim 10, wherein the frames that are added and/or removed are evenly distributed throughout an MRI cine loop.

13. (Original) The method of Claim 1, wherein the MRI cine loops are compensated such that corresponding frames in each of the plurality of MRI cine loops correspond to a common relative time within a cardiac cycle of the patient.

14. (Original) The method of Claim 1, wherein the MRI cine loops are compensated so that differing heart rates of the patient visually appear to have a same duration.

15. (Original) The method of Claim 1, wherein adjusting the plurality of MRI cine loops comprises adjusting a duration of display of frames of a least one of the plurality of MRI cine loops such that each of the MRI cine loops has a common total duration.

16. (Original) The method of Claim 15, wherein each of the MRI cine loops has a duration of at least one full cardiac cycle.

17. (Original) The method of Claim 15, wherein frames for which the duration is adjusted are evenly distributed throughout the MRI cine loop.

18. (Original) The method of Claim 1, wherein evaluation the compensated MRI cine loops comprise comparing at least two of the plurality of cine loops to each other.

19. (Original) The method of Claim 18, wherein one of the at least two of the plurality

of cine loops is a baseline MRI cine loop.

20. (Previously Presented) The method of Claim 19, further comprising registering frames of the plurality of MRI cine loops to the baseline MRI cine loop.

21. (Previously Presented) A method of displaying MRI cine loops comprising:
adjusting a characteristic of one frame of a plurality of frames of an MRI cine loop, wherein the MRI cine-loops are generated using multiple MRI images that form the frames of the cine loops, wherein the characteristic is at least one of contrast, brightness, and gamma; and

propagating the adjustment of the one frame to other frames of the MRI cine loop.

22. (Previously Presented) The method of Claim 21, further comprising:
displaying a plurality of MRI cine loops during the adjusting step; and
automatically propagating the adjustment of the one frame of the MRI cine loop to frames of the other MRI cine loops.

23. (Original) The method of Claim 21, wherein adjusting a characteristic comprises cropping a frame of the plurality of frames to provide a portion of the frame.

24. (Previously Presented) The method of Claim 21, wherein adjusting a characteristic comprises adjusting a contrast or brightness of a display level of the frame.

25. (Previously Presented) A method according to Claim 1, further comprising obtaining MRI images for the MRI cine loops using a fast gradient echo segmented k-space sequence having sufficient temporal resolution for identification of end of systole, the temporal resolution being between about 13-65 ms, with lower times corresponding to faster heart beats and higher times corresponding to slower heartbeats, and wherein the MRI cine loops are obtained

using breathhold durations between about 10-23 seconds, the longer breathhold durations associated with faster heart beat rates.

26. (Previously Presented) The method of Claim 21, further comprising adding frames to at least one of the plurality of MRI cine loops with the added frames substantially evenly distributed through the at least one cine loop so that the cine loops represent different heart beats that are synchronized.

27. (Previously Presented) The method of Claim 21, further comprising electronically storing the adjusted characteristic and subsequently displaying the MRI cine loops with the adjusted characteristic at a later time.

28. (Previously Presented) The method of Claim 1, further comprising electronically automatically comparing a baseline MRI cine loop of the patient to MRI cine loops at different heart rates.

29. (Previously Presented) The method of Claim 28, further comprising electronically registering the differing MRI cine loops to the baseline loops such that corresponding pixels of the cine loops or portions of the cine loops are each associated with approximately a same physical location within the patient.

30. (Previously Presented) The method of Claim 1, wherein the allowing a clinician to electronically select step comprises providing electronic user inputs displayed apart from the display images of the MRI cine loops that are associated with selectable views and doses of the MRI cine loops that allow a user to select both at least one view and at least one dose amount for the MRI cine loops for the displaying step.

31. (Previously Presented) The method of Claim 25, wherein acquiring step is carried out using the k-space segmentation and breathhold durations for the specified differing heart rates according to:

Heart Rate (beats/min)	Views per Segment	Temporal Resolution (msec)	Breathhold Duration (sec)
<55	10	65	10
55-65	8	52	13-11
65-95	6	39	15-10
95-125	4	26	15-12
125-170	2	13	23-17

32. (Previously Presented) A cardiac diagnostic workstation, comprising:
a workstation with a display in communication with an MRI scanner;
wherein the display is configured to display a plurality of different views of temporally synchronized MRI cine-loops of the heart of a patient in the MRI scanner in substantially real-time while the patient is in the MRI scanner, the MRI cine-loops adjusted to have substantially the same duration, the different views comprising some views associated with a first anatomical view of the heart of the patient at different heart rates induced by different doses of a stress-inducing substance and some views associated with different anatomical views of the heart of the patient at a substantially constant heart rate, wherein the MRI cine-loops are generated using multiple MRI images that form the frames of the cine loops, wherein the display is configured to accept user input to electronically select at least one dose amount and/or at least one anatomical view whereby selected MRI cine loops are displayed responsive thereto to allow a clinician to evaluate cardiac function and physiology during a stress test whereby the cine loops are displayed during the stress test to allow a physician to assess cardiac physiology of a patient so as to adjust parameters of the test and/or avoid injury to the patient thereby providing safer cardiac stress testing.

33. (Previously Presented) A method according to Claim 1, wherein the step of allowing the clinician to electronically select at least one of the following: (a) at least one dose amount; (b) at least one view; or (c) at least one dose amount and at least one view to define the MRI cine loops for the displaying step allows the clinician to select each of (a), (b) and (c), and wherein the step of allowing the clinician to select is carried out to allow the clinician to rapidly switch between various display mechanisms.

34. (Previously Presented) A workstation according to Claim 31, wherein the display is configured to accept user input to electronically select a plurality of dose amounts and a plurality of side-by-side anatomical views in response to clinician input whereby selected MRI cine loops are displayed responsive thereto, and wherein the display is configured to rapidly switch between various display mechanisms for evaluating the MRI cine loops of different doses of the stress-inducing substance at a same location of the heart and different locations of the same dose of the stress inducing substance.

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Evidence Appendix

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Related Proceedings Appendix

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